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Qualitative Analysis of Pesticide Residues in Tomato Crops from Rampur Area Using GC-MS

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ABSTRACT

This study set out to evaluate the levels of pesticide residue that are frequently applied to tomato crops in Rampur area. It was discovered that agricultural areas were using a significant amount of pesticides, including fungicides and insecticides. After QuEChERS extraction, a total of five tomato samples were analyzed using gas chromatography-mass spectrometry (GC-MS/MS) multi-residue analysis. Five pesticides were found in three samples: dipenoconazole, methomyl, triadimenol, metalaxyl, and chlorpyriphos. Five of these samples included residues from two different types of pesticides. The methomyl residue level in one sample was higher than the maximum limit set by the EU (MRLs). According to our research, pesticide abuse is commonplace and there is a glaring disrespect for good agricultural practices. Pesticides should be checked for on a regular basis to safeguard consumer health.

Keywords: Pesticide Residues, Tomato, GC-MS.

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INTRODUCTION

When plants are growing and being conserved, pests are often controlled with the application of pesticides. It is now widely accepted that the use of pesticides in agriculture leaves behind invisible residues on food that may be extremely dangerous to the health of consumers. Tomatoes and other frequently consumed crops are particularly vulnerable to pests, posing a serious risk. In order to protect consumer health and the environment, numerous rules, known as Maximum Residue Limits (MRLs) on treated foods, were developed to keep pesticide levels below acceptable thresholds [1]. MRLs stand for effective farming practices that yield residue levels without endangering public health. They are grounded in agronomic and toxicological studies. However, since the allowed limits are continually dropping, specific and sensitive analytical processes must be developed in order to identify and quantify extremely low concentrations of pesticides [2].

This prompted us to conduct a study to evaluate the pesticide residue levels in fresh tomatoes and their compliance with maximum residual levels. A descriptive study of the use of pesticides in agriculture is the general methodology, and it covers a number of agricultural fields in the western part of the nation. Farmers in these areas gave information on pesticide use using a specific survey. The matrix selection is centered on the tomato crop, which is the most important and prevalent crop in these locations. Fresh tomatoes can also be consumed whole. Moreover, tomato crops are known to be sensitive, which contributes to a high rate of pesticide use [3,4]. At the Pharmacology-Toxicology Department of Oran University Hospital, tomato samples collected from crop fields were examined. QuEChERS (Quick, Easy, Cheap, Effective,

Rugged, and Safe) extraction technology will be improved, and a method for identifying numerous residues utilizing a gas chromatographic chain linked to a mass spectrometer (GC-MS/MS) will be developed and validated.

Pesticides

Pesticides are substances that are used as pest control agents. This includes bactericides, microbicides, fungicides, and lampricides in addition to insecticides for insects, rodents, and mammals. Food and Agriculture Organization (FAO) definitions of pesticides include any material or mixture of materials intended to prevent, eliminate, or control any pest, including those that disperse disease to people or animals, unwanted plant or animal species, and materials that injure or otherwise obstruct food production, processing, storage, transportation, or marketing. Agricultural products, timber and wood products, animal feed, and materials that can be administered to animals to control insects, arachnids, or other pests in or on their bodies are also included [5].

Pesticide Effects

These are manufactured with dangerous chemicals that are meant to be purposefully released into the environment. Despite the fact that every pesticide is designed to kill a certain kind of bug, a significant percentage of pesticides wind up somewhere other than their intended target. Instead, they end up in our food, the water, the air, and the sediments. Pesticides have been linked to a multitude of health hazards for humans, from short-term symptoms like headaches and nausea to long-term consequences including cancer and reproductive harm. Moreover, the overall biodiversity of the soil is decreased by employing these. Pesticide-free soil has higher quality because it retains more soil, which is necessary for plant growth [6].

Object and Study Area

The experiment's goal was to find out if tomatoes from the Rampur region had pesticide residues. District Rampur is located between longitudes 78-0-54 & 69-0-28 East and latitudes 28-25 and 29-10 North. It is situated in the Moradabad Division of the state of Uttar Pradesh and is dispersed over 2367 square kilometers. It is surrounded by the districts of Badaun in the south, Bareilly in the east, Moradabad in the west, and Udham Singh Nagar in the north. Rampur is a city and the municipality's main administrative center for the Rampur District in the Indian state of Uttar Pradesh. In the past, it was well-known for a range of industries, such as sugar and cotton refining. Its library contains more than 12,000 unique manuscripts and a superb collection of Mughal miniature paintings. It is 322 kilometers northwest of Lucknow, the state capital.

MATERIAL AND METHODS

Sample Preparation:

5–10 grams of the sample were placed in a 50 ml centrifuge tube made of polypropylene. Add 10 milliliters of Mili Q water, mix thoroughly, and then add 10 milliliters of Acetonitrile with 0.1% formic acid. added 0.5 grams of sodium acetate or QUECHERS Pouch and 2.0 grams of anhydrous magnesium sulfate. Give a firm handshake, then vortex for two minutes. For five minutes, centrifuge the tube at 5000 rpm. 4–8 ml of the supernatant were pipetted into a 15 ml tube that previously contained 200–500 mg of anhydrous magnesium sulfate and 100–200 mg of PSA. Alternatively, 2 ml of supernatant could be added to a 2 ml dispersive SPE tube. Centrifuged at 5000 rpm for 5 minutes after 1 minute of vortexing. 2 milliliters were pipetted out, dried under nitrogen gas, and 1.0 milliliter was made up with ethanol acetate for GCMS/MS. Use a 0.22µ nylon syringe filter as a filter.

Instrumental identification and quantification techniques

The two main analytical techniques used in food analysis are gas chromatography and liquid chromatography, both of which make pesticide detection and measurement possible. GC is used in conjunction with several quantification techniques to choose the pesticide class to be quantified [7]. Various techniques have been employed to quantify the existence of pesticide residues in grain samples, such as electron capture detection (ECD), nitrogen-phosphorus detection (NPD), flame-ionization detection (FID), and mass-selective detection (MSD).

The Gas Chromatography/Mass Spectrometry (GC/MS) instrument is utilized for molecular component identification (the MS component) and chemical mixture separation (the GC component).

It is one of the most accurate tools for analyzing data from environmental samples that is currently accessible. The GC works on the principle that heat causes a mixture to split into its component parts. The heated gases pass through a column of inert gas (helium, for example). When the separated components leave the column aperture, they enter the MS. Mass spectrometry uses the mass of the analyte molecule to identify compounds. A "library" of known mass spectra covering hundreds of chemicals is stored on a computer [8].

RESULTS AND DISCUSSION

In total, five pesticides have been found in this investigation, and they fall into three categories: fungicides, insecticides, and herbicides. Additionally, our research indicates the usage of some broad-spectrum pesticides, such acaricides, which include methomyl and chlorpyriphos, and nematicides, which are insecticides like ethoprophos [9].

The analytical data clearly shows that there were measurable pesticide residues in three of the samples. The fungicides difenoconazole, triadimenol, and metalaxyl were more frequently observed than the insecticides methomyl and chlorpyriphos. Fungicides accounted for two of the pesticide residues discovered in the GC-MS/MS analysis of five tomato samples. This high percentage of fungicide use can be explained by the high frequency of fungal attacks, the greater sensitivity of tomato crops to fungal pests when compared to insects, and farmers' strong worry about fungal pests on tomatoes [10].

In our samples, the fungicides triadimenol and difenoconazole are most frequently found. The triazole family, comprising these two fungicidal drugs, is widely used for crop treatment, especially in tomato production. The descriptive survey's findings show that, although insecticides are commonly employed to treat tomato crops, they are less commonly found in positive tomato samples than fungicides. This is probably because pesticides are environmentally fragile because of oxidation and hydrolysis, and they are easily destroyed by sunshine in as little as two days. They are also susceptible to bacteria and photolysis [11].

A sample containing methomyl outperformed the MRL. The presence of this pesticide on a food that is frequently consumed raw, like tomatoes, is quite concerning because it is known to be neurotoxic and to inhibit cholinesterase, a member of the carbamate family. Repeated or prolonged exposure to methomyl may result in a cumulative decrease in cholinesterase activity. Most medical professionals believe that pesticides are connected to a variety of diseases, such as cancer, neurological conditions, and endocrine disruption [12, 13].

Moreover, methomyl is no longer registered, according to the IPPUA. Twenty percent of the samples under examination included traces of two different types of pesticides. The rise in residues discovered can be ascribed to inadequate compliance with advised farming practices (doses, pre-harvest delays), which is intimately related to the advancement of analytical techniques, especially sensitivity, made feasible by GC-MS/MS equipment. In certain instances, two fungicides from the same family with the same properties and action spectrum were found. This suggests the use of these items in an erratic or possibly irrational way.

CONCLUSIONS

The current study evaluated the amounts of pesticide residue in fresh tomato samples that were collected from Rampur. The numbers found are significant and may raise questions about potential harm to consumers' health. To more correctly assess food safety, this study should be expanded to include a more representative sample program, additional pesticides and their degradation products, a longer collection time, and other matrices. These preliminary results, which are based on a national plan for monitoring pesticide residues, may serve to further emphasize the necessity for Algeria to enact a more comprehensive and strict regulation for the use of pesticides.

REFERENCES

1. Alamgir Zaman Chowdhury M, Fahruddin ANM, Nazrul IM, Moniruzzaman M, Gan SH, Khorshed A. 2013. Detection of the residues of nineteen pesticides in fresh vegetable sam- ples using gas chromatography mass spectrometry. Food Control. 34(2), 457–465.

doi:10.1016/j.foodcont.2013.

2. Alejandro Arias L, Bojacá CR, Ahumada DA, Schrevens E. 2014. Monitoring of pesticide residues in tomato marketed in Bogota, Colombia. Food Control. 35(1), 213–217. doi:10.1016/j.foodcont.2013.06.046.

3. Algharibeh GR, AlFararjeh MS. 2019. Pesticide residues in fruits and vegetables in Jordan using liquid chromatogra- phy/tandem mass spectrometry. Food Add Contam Part B. 12(1):65–73. doi:10.1080/19393210.2018.1548505.

4. Al-Nasir FM, Jiries AG, Al-Rabadi GJ, Alúdatt MH, Tranchant CC, Al-Dalaim SA, Alrabadi N, Madanat OY, Al-Dmour RS. 2020. Determination of pesticide residues in selected citrus fruits and vegetables cultivated in the Jordan Valley. LWT-Food Sci Technologie. 123, 109005. doi:10.1016/j.lwt.2019.109005.

5. Andrade GCRM, Monteiro SH, Fransisco JG, Figueiredo LA, Botelho RG, Totnisielo VL. 2014. Liquid chromatography-electrospray ionization tandem mass spectrometry and dynamic multiple reaction monitoring method for determining multiple pesticide residues in tomato. Food Chem. 175, 57–65. doi:10.1016/j. foodchem.2014.11.105.

6. Bakirci GT, Acay DBY, Bakirci F, Ötles S. 2014. Pesticide residues in fruits and vegetables from the Aegean region, Turkey. Food Chem. 160, 379–392. doi:10.1016/j.foodchem.2014.02.051.

7. Benzidane C, Dahamna S. 2013. Chlorpyriphos residues in food plant in the region of Setif-Algeria. Agri Appl Biol Sci. 78(2):157–160.

8. Bojacá CR, Arias LA, Ahumada DA, Casilimas HA, Schrevens E. 2012. Evaluation of pesticide residues in open field and green- house tomatoes from Colombia. Food Control. 30(2), 400–403. doi:10.1016/j.foodcont.2012.08.015.

9. Golge O, Kabak B. 2015. Evaluation of QuECheRS sample preparation and liquid chromatography-triple-quadrupole mass spectrometry method for the determination of 109 pesticide residues in tomatoes. Food Chem. 176, 319–332. doi:10.1016/j.foodchem.2014.12.083.

10. Omwenga I, Kanja L, Zomer P, Louisse J, Rietjens MCMI, Mol H. 2021. Organophosphate and carbamate pesticide residues and accompanying risks in commonly consumed vegetables in Kenya. Food Add Contam Part B. 14(1), 48–58. doi:10.1080/19393210.2020.1861661.

11. Stachniuk A, Formal E. 2016. Liquid chromatography-Mass spectrometry in the analysis of pesticide residues in food. Food Anal Methods. 9, 1654–1665. doi:10.1007/s12161-015-0342-0.

12. Vander Mark M, Brouwer M, Kromhout H, Nijssen P, Huss A, Vermeulen R. 2012. Is pesticide use related to Parkinson disease? Some clues to heterogeneity in study results. Environ Health Perspect. 120(3), 340–347. doi:10.1289/ehp.1103881.

13. Wilkowska A, Biziuk M. 2011. Determination of pesticide residues in food matrices using the QuEChERS methodology. Food Chem. 125(3), 803–812. doi:10.1016/j. foodchem.2010.09.094.

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